INDOOR AIR QUALITY REASSESSMENT

Massachusetts Department of Public Health
Division of Health Professions Licensure
239 Causeway Street
Boston, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Center for Environmental Health
Emergency Response/Indoor Air Quality Program
April 2006

Background/Introduction

In response to a request from Sally Graham, Executive Director of the boards of registration for nursing home administrators, perfusionists, physicians assistants and respiratory care, for the Massachusetts Department of Public Health (MDPH), Division of Health Professions Licensure (DHPL), the MDPH, Center for Environmental Health (CEH), provided assistance and consultation regarding indoor air quality concerns at the DHPL, 239 Causeway Street, Boston, MA. The request was prompted by occupant reports of symptoms (e.g., dry, itchy eyes, runny nose, scratchy throat, coughs, and exacerbation of asthma) and concerns over a possible connection to environmental conditions within the building. On March 8, 2006, a visit to the DHPL to conduct an indoor air quality assessment was made by Cory Holmes, an Environmental Analyst in CEH's Emergency Response/Indoor Air Quality (ER/IAQ) Program. Mr. Holmes was accompanied during the assessment by Gary Pyne, of PMC Mechanical Controls, the building's mechanical ventilation vendor and Ms. Graham.

The facility at 239 Causeway Street is a five-story brick office building, originally built as a factory/warehouse in the late 1800's. The DHPL has occupied space on the 4th floor for approximately 5 years. The DHPL floor space consists of perimeter offices and centralized cubicles (Picture 1).

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor. MDPH staff also performed a visual inspection of building materials for water damage and/or microbial growth.

Results

The DHPL has a staff of 50 to 60 and may be visited by up to 100 members of the public on a daily basis. The tests were taken under normal operating conditions. Test results appear in Table 1. (Note: results are listed in the Table by occupant last name or location that the air sample was taken.)

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were above 800 parts per million parts of air [ppm] in all areas surveyed, which is indicative of poor air exchange. Ventilation is provided by a heating, ventilation and air conditioning (HVAC) system. Fresh air is introduced by a rooftop-mounted air-handling unit (AHU) (Picture 2). Heat pumps are located above ceiling tiles to facilitate airflow. Transfer air from the AHU is drawn into the heat pumps and delivered to work stations via ceiling-mounted air diffusers (Picture 3). Exhaust ventilation is provided by drawing air through metal/plastic grates into a ceiling plenum, which returns air to the AHUs where it is exhausted (Picture 5).

The ventilation system is controlled by mercury-switch thermostats (Picture 6). Thermostats have a fan switch, which can be set to either “auto” or “on”. The “automatic” setting on the thermostat activates the ventilation system at a preset temperature. Once the preset temperature is reached, the system is deactivated. Therefore, no mechanical ventilation is provided until the thermostat re-activates the system. At the time of the assessment, switches were set to the fan “auto” setting (Picture 7).

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, see Appendix A.

Temperature measurements ranged from 72^{o} F to 76^{o} F, which were within the MDPH recommended comfort range in all areas surveyed. The MDPH recommends that

indoor air temperatures be maintained in a range of 70° F to 78° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. Although temperature measurements were within the MDPH recommended range on the day of the assessment, a number of temperature complaints were expressed by staff. Mr. Pyne reported this is most likely a result of out-dated mercury-containing thermostats, which have a slow response time and are difficult to calibrate.

The relative humidity in this building ranged from 19 to 30 percent, which were below the MDPH recommended comfort range for all areas. The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels would be expected to be lower during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

A few areas contained plants. Moistened plant soil and drip pans can be a source of mold growth. Plants should be equipped with drip pans. Plants are also a source of pollen. Plants should be located away from the air stream of ventilation sources to prevent the aerosolization of mold, pollen or particulate matter.

A few water damaged ceiling tiles were observed, which can indicate a plumbing leak or condensation from the HVAC system. Water-damaged ceiling tiles can provide a source of microbial growth and should be replaced after a water leak is discovered.

Other Concerns

Several conditions that can potentially affect indoor air quality were also identified. Occupants expressed concern regarding the condition and cleaning of carpeting in several areas. Ms. Graham reported that a plan was in place for carpet replacement. The Institute of Inspection, Cleaning and Restoration Certification (IICRC), recommends that carpeting be cleaned annually or semi-annually in soiled high traffic areas (IICRC, 2005).

MDPH staff inspected the HVAC system for filtration, which is provided by dual filtration. The rooftop AHU is equipped with high efficiency-pleated filters (Picture 8), which removes airborne particulates at the source. Air is then distributed to localized heat pumps throughout the space, where they are filtered a second time prior to being distributed via air diffusers. Mr. Pyne reported that filters are changed every two weeks due to construction activity adjacent to the building (Picture 9).

Lastly, DHPL staff frequently use VOC-containing cleaning materials (Pictures 10 and 11) to clean their personal work areas. These materials contain several VOCs (e.g., isopropyl alcohol and monoethanolamine) that can be irritating to the eyes, nose and throat (3M, 2000).

Conclusions/Recommendations

In view of the findings at the time of this visit, the following recommendations are made to improve indoor air quality:

1. Set thermostat controls in the fan "on" position to provide continuous air exchange during periods of occupancy.
2. Remove blockages to supply air diffusers (Picture 3).
3. Continue working with building management and HVAC consultant to improve areas of ventilation/temperature complaints.
4. Consider replacing mercury containing thermostats with digital/programmable thermostats to improve temperature control.
5. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
6. Replace water-damaged ceiling tiles. Examine above and around these areas for microbial growth. Disinfect areas of water leaks with an appropriate antimicrobial as needed.
7. Avoid over watering of plants. Ensure flat surfaces around plants are free of potting soil and other plant debris. Examine drip pans periodically for mold growth and disinfect with an appropriate antimicrobial where necessary.

8. Discontinue the use of VOC-containing cleaners. Less irritating materials, (soap and water) may suffice to clean in these areas.

9. Clean supply and return diffusers periodically of accumulated dust.

10. Continue with plans to replace carpeting in DHPL space.

11. Consider cleaning carpeting annually (or semi-annually in soiled high traffic areas) as per the recommendations of the Institute of Inspection, Cleaning and Restoration Certification (IICRC). Copies of the IICRC fact sheet can be downloaded at: http://www.cleancareseminars.com/carpet_cleaning_faq4.htm (IICRC, 2005)

References

BOCA. 1993. The BOCA National Mechanical Code-1993. 8th ed. Building Officials & Code Administrators International, Inc., Country Club Hills, IL. M-308.1

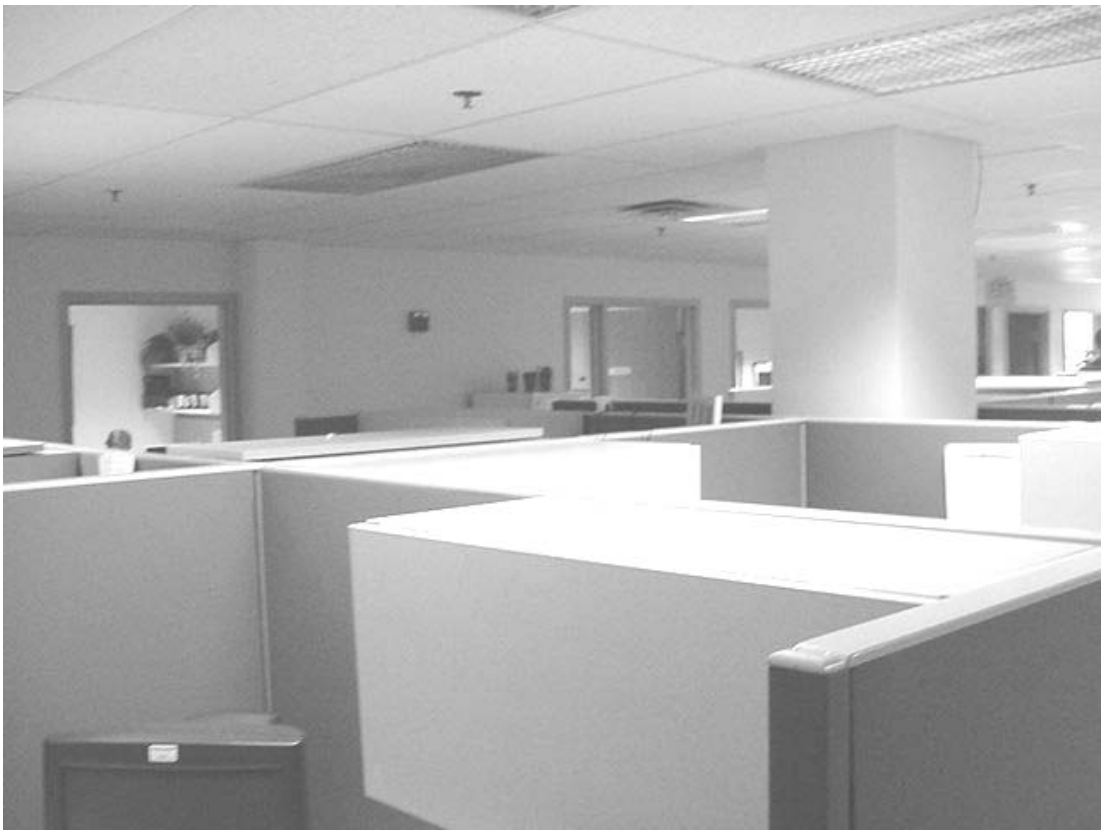
IICRC. 2005. Carpet Cleaning FAQ 4 Institute of Inspection, Cleaning and Restoration Certification. Institute of Inspection Cleaning and Restoration, Vancouver, WA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R. 1910.1000 Table Z-1-A.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

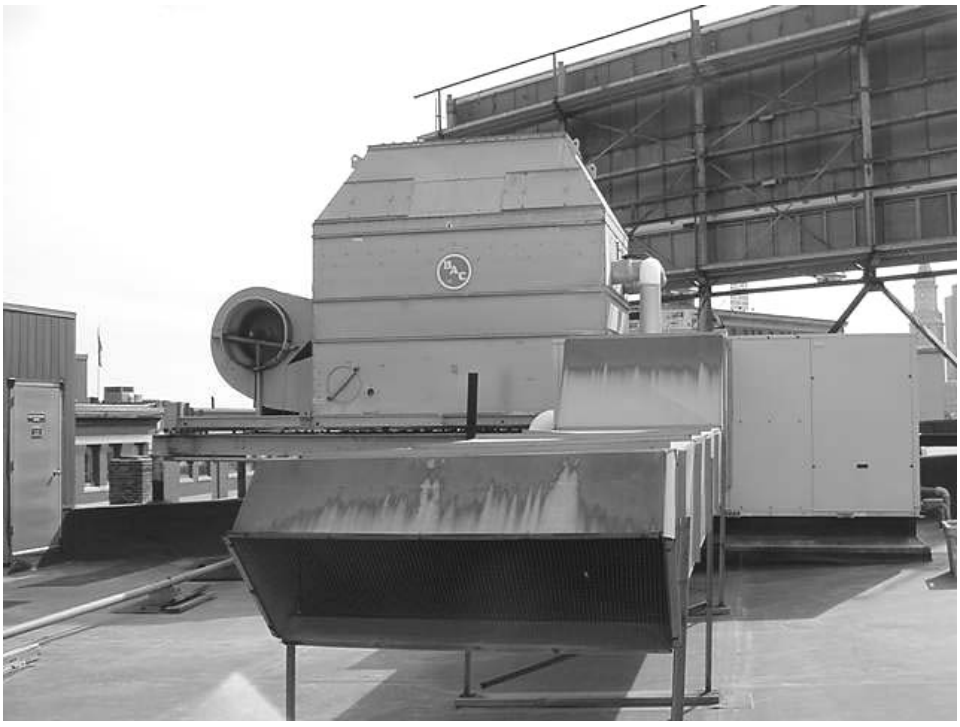
3M 2000. Material Safety Data Sheet (MSDS Document No: 10-0157-7). 3M Brand Desk and Office Cleaner 573. Minnesota Mining and Manufacturing Company. St. Paul, Minnesota.

Picture 1



Centralized Cubicles and Perimeter Offices on the 4th Floor

Picture 2

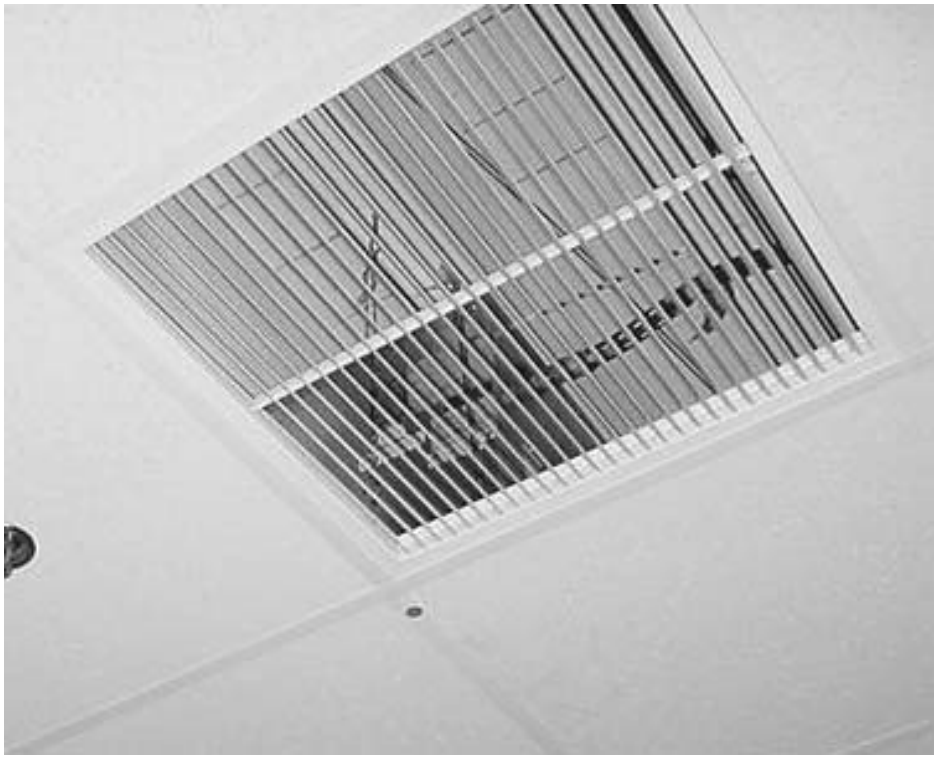


Fresh Air Intake for Rooftop AHU, Cooling Tower in Background

Picture 3

Ceiling-Mounted Air Diffuser, Note Diffuser is Blocked with Paper

Picture 4

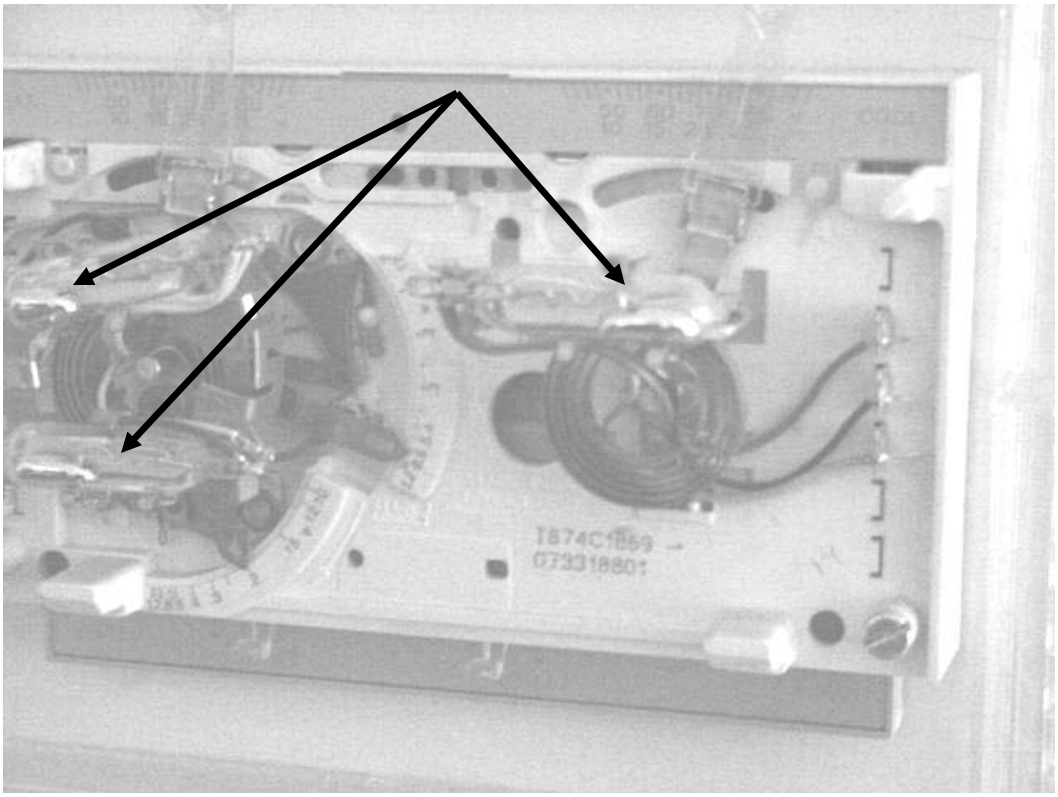


Grated Ceiling Vent for Return System

Picture 5

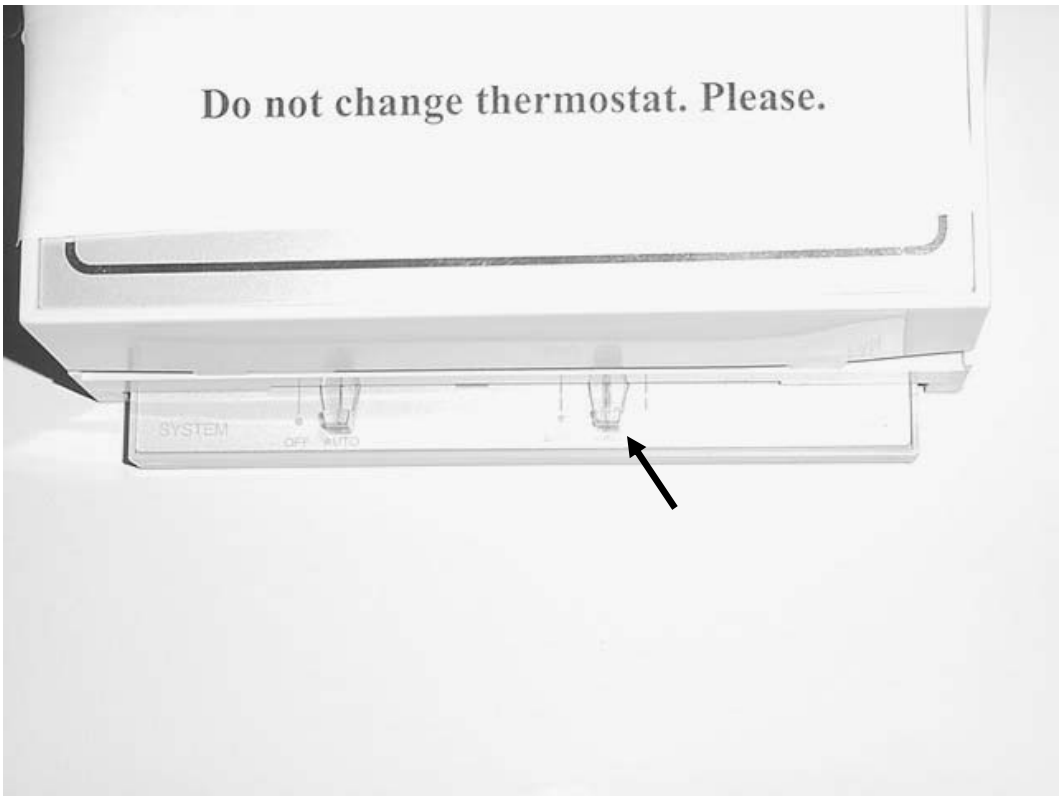
Exhaust Vent on Rooftop AHU

Picture 6



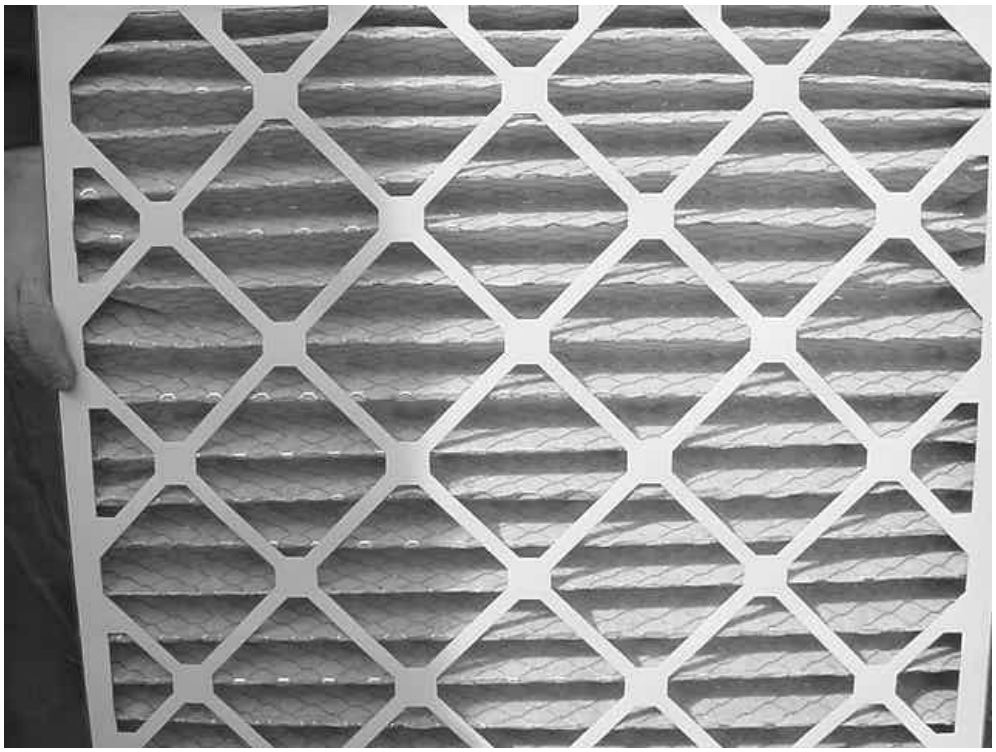
Mercury-Containing Ampoules inside Thermostat

Picture 7



HVAC Thermostat, Note Fan in "Auto" Position

Picture 8



High-Efficiency Pleated Air Filters in Rooftop AHU

Picture 9

Construction Activity Adjacent to 239 Causeway Street

Picture 10

Spray Office Cleaner, Note Label "May Cause Eye Irritation"

Picture 11

Spray Office Cleaner, Note Label "May Cause Eye Irritation"

TABLE 1

Indoor Air Test Results – Division of Health Professions Licensure, Boston, MA – March 8, 2006

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Background	392	42	25					Unseasonably warm
Millar	1047	73	22	1	N	Y	Y	Printer near thermostat
Manning	1035	76	21	1	Y	Y	Y	Window difficult to open, temperature control complaints
Strachan	950	76	19	0	Y	Y	Y	Plants
Law	980	76	19	1	N	Y	Y	1 WD CT
DiFabio	1038	72	30	1	N	Y	Y	Fan
Erickson	1042	76	21	2	N	Y	Y	Fan
Cittadino	1035	76	20	1	N	Y	Y	Cold complaints
Tosado	1123	76	21	1	Y	Y	Y	
Langner	979	74	20	1	N	Y	Y	
Banks	992	75	20	0	N	Y	Y	Plant

*** ppm = parts per million parts of air**
WD = water damage, CT = ceiling tile

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1

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Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Dolberg	960	74	19	1	N	Y	Y	
Williams	1026	75	20	1	N	Y	Y	
421 Scanner	1037	76	20	1	N	Y	Y	

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